

# What happens to marine life when oxygen is scarce?

July 26 2021

---



Credit: CC0 Public Domain

In September 2017, Woods Hole Oceanographic Institution postdoctoral scholar Maggie Johnson was conducting an experiment with a colleague in Bocas del Toro off the Caribbean coast of Panama. After sitting on a

quiet, warm open ocean, they snorkeled down to find a peculiar layer of murky, foul-smelling water about 10 feet below the surface, with brittle stars and sea urchins, which are usually in hiding, perching on the tops of coral.

This unique observation prompted a collaborative study explained in a new paper published today in *Nature Communications* analyzing what this foggy water layer is caused by, and the impact it has on life at the bottom of the seafloor.

"What we're seeing are hypoxic ocean waters, meaning there is little to no oxygen in that area. All of the macro-organisms are trying to get away from this deoxygenated water, and those that cannot escape essentially suffocate. I have never seen anything like that on a coral [reef](#)," said Johnson.

The study looks closely at the changes occurring in both coral reef and [microbial communities](#) near Bocas del Toro during sudden hypoxic events. When water drops below 2.8mg of oxygen per liter, it becomes hypoxic. More than 10% of [coral reefs](#) around the world are at high risk for hypoxia ([Altieri et al. 2017, Tropical dead zones and mass mortalities on coral reefs](#)).

"There is a combination of stagnant water from low wind activity, warm water temperatures, and nutrient pollution from nearby plantations, which contributes to a stratification of the water column. From this, we see these hypoxic conditions form that start to expand and infringe on nearby shallow habitats," explained Johnson.

Investigators suggest that loss of oxygen in the global ocean is accelerating due to climate change and excess nutrients, but how sudden deoxygenation events affect tropical marine ecosystems is poorly understood. Past research shows that rising temperatures can lead to

physical alterations in coral, such as bleaching, which occurs when corals are stressed and expel algae that live within their tissues. If conditions don't improve, the bleached corals then die. However, the real-time changes caused by decreasing oxygen levels in the tropics have seldom been observed.

At a local scale, hypoxic events may pose a more severe threat to coral reefs than the warming events that cause mass bleaching. These sudden events impact all oxygen-requiring marine life and can kill reef ecosystems quickly.

Investigators reported coral bleaching and mass mortality due to this occurrence, causing a 50% loss of live coral, which did not show signs of recovery until a year after the event, and a drastic shift in the seafloor community. The shallowest measurement with hypoxic waters was about 9 feet deep and about 30 feet from the Bocas del Toro shore.

What about the 50% of coral that survived? Johnson and her fellow investigators found that the coral community they observed in Bocas del Toro is dynamic, and some corals have the potential to withstand these conditions. This discovery sets the stage for future research to identify which coral genotypes or species have adapted to rapidly changing environments and the characteristics that help them thrive.

Investigators also observed that the microorganisms living in the reefs restored to a normal state within a month, as opposed to the macroorganisms, like the brittle stars, who perished in these conditions. By collecting sea [water](#) samples and analyzing microbial DNA, they were able to conclude that these microbes did not necessarily adjust to their environment, but rather were "waiting" for their time to shine in these low-oxygen conditions.

"The take home message here is that you have a community of microbes;

it has a particular composition and plugs along, then suddenly, all of the oxygen is removed, and you get a replacement of community members. They flourish for a while, and eventually hypoxia goes away, oxygen comes back, and that community rapidly shifts back to what it was before due to the change in resources. This is very much in contrast to what you see with macro-organisms," said Jarrod Scott, paper co-author and postdoctoral fellow at the Smithsonian Tropical Research Institute in the Republic of Panama.

Scott and Johnson agree that human activity can contribute to the nutrient pollution and warming waters which then lead to hypoxic ocean conditions. Activities such as coastal land development and farming can be better managed and improved, which will reduce the likelihood of deoxygenation events occurring.

The study provides insight to the fate of microbe communities on a coral reef during an acute deoxygenation event. Reef microbes respond rapidly to changes in physicochemical conditions, providing reliable indications of both physical and biological processes in nature.

The shift the team detected from the hypoxic microbial community to a normal condition community after the event subsided suggests that the recovery route of reef microbes is independent and decoupled from the benthic macro-organisms. This may facilitate the restart of key microbial processes that influence the recovery of other aspects of the reef community.

**More information:** Maggie D. Johnson et al, Rapid ecosystem-scale consequences of acute deoxygenation on a Caribbean coral reef, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-24777-3](https://doi.org/10.1038/s41467-021-24777-3)

Provided by Woods Hole Oceanographic Institution

Citation: What happens to marine life when oxygen is scarce? (2021, July 26) retrieved 19 April 2024 from <https://phys.org/news/2021-07-marine-life-oxygen-scarce.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.